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REMARKS

Attorney wishes to thank the Examiner for re-issuing the Office Action which originally issued February 27, 2002, indicating a non-Final Action on the cover sheet but including form paragraphs in the body of the Office Action indicating a Final Action.

Objection to the Specification

In Paragraph 1 of the Office Action, the Examiner objects to the use of the term "RMS" and requires that it be defined. Attorney respectfully submits that one of ordinary skill in any field of engineering, including marine structural design, would understand RMS to be the root-mean-square of the parameter being measured. See www.m-w.com, and the definition of RMS. As such, no further explanation is actually required. Nonetheless, Attorney has amended the paragraph beginning at page 8, line 7 to define RMS.

Rejection of Claims 2, 3, 5 and 6 under 35 U.S.C. §112, ¶2

In Paragraph 2 of the Office Action, the Examiner rejects claims 2, 3, 5 and 6 under 112, second paragraph for failing to distinctly claim the subject matter which the applicant regards as the invention, more particularly for varying the definition of D. Attorney has amended the claims to independent form, mooted the basis for rejection.

Rejection of Claims 1 – 6 under 35 U.S.C. §102

In Paragraphs 3 of the Office Action, the Examiner rejects claims 1 – 6 as being anticipated by U.S. Patent 4,470,722 to Gregory '722. Specifically, the Examiner states that Gregory '722 discloses a marine production facility having a fiberglass or plastic housing. The Examiner states that while ultra-smooth is never explicitly stated in Gregory '722, the citation by Applicant that an ultra-smooth surface could be provided any sufficiently smooth surface. Since Gregory '722 discloses plastic, the Examiner makes the intuitive leap that Gregory '722 must have a K/D ratio in the range claimed by the present invention. Attorney respectfully traverses this ground for rejection.

As noted previously, the Examiner engages in the false analogy logic fallacy and that, without support, it is improper to suggest that the fiberglass or plastic of Gregory '722 would have the same ultra-smooth characteristics of the claimed invention. The Examiner's very reasoning was rejected by the Federal Circuit in *Crown Operations Int'l Ltd. v. Solutia, Inc.*, 289 F.3d 1367 (Fed. Cir. 2002):

Crown urges us to accept the proposition that if a prior art reference discloses the same structure as claimed by a patent, the resulting property, in this case, two percent solar control film reflectance, should be assumed. We decline to adopt this approach because this proposition is not in accordance with our cases on inherency. If the two percent reflectance limitation is inherently disclosed by the Gillery patent, n2 it must be necessarily present and a person of ordinary skill in the art would recognize its presence. *In re Robertson*, 169 F.3d 743,745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999); *Continental Can*, 948 F.2d at 1268, 20 USPQ2d at 1749. Inherency "may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." 948 F.2d at 1269, 20 USPQ2d at 1749 (quoting *In re Oelrich*, 666F.2d 578, 581, 212 USPQ 323, 326 (CCPA 1981).

Crown Operations, 289 F.3d at 1377 (footnote omitted).

Herein, the Examiner is merely suggesting that the materials disclosed in the present application, having been disclosed in Gregory '722, would necessarily have the same smoothness characteristics. In light of the established law, the Examiner has failed to come forth with additional material which would suggest that the K/D ratios claimed herein would necessarily be present in the materials disclosed in Gregory '722. As such, the amended claims 1 – 6 are patentable over Gregory '722.

In Paragraph 4 of the Office Action, the Examiner rejects claims 1 and 2⁴ as being anticipated by Allen, D. et al. *Vortex-Induced Vibration Tests of a Flexible Smooth Cylinder at Supercritical Reynolds Numbers*, May 1997. Attorney respectfully traverses the rejection.

The Examiner is correct that the Allen Article discloses PVC plastic cylinders having a K/D ratio in the range of 8.86×10^{-5} to 1.09×10^{-4} and ABS cylinders having a K/D ratio in the range of 1.21×10^{-4} to 1.51×10^{-4} . However, as noted in Dr. Allen's Declaration, attached as Exhibit A, at ¶11, this surface smoothness was achieved only as a result of specific selection, handling of the material and preparation of the surface. The K/D ratios for the materials were not inherent in the materials themselves.

The Examiner incorrectly draws the conclusion that VIV, together with drag, is reduced as a result of surface smoothness, citing the Stationary Cylinder Results at pg. 683 of the article. As noted in the paper and in the Allen Declaration ¶13, the stationary cylinders had a strongback inserted and the cylinders were not free to vibrate and could not undergo VIV "(aluminum pipe insert used to keep the pipe from vibrating)." The stationary cylinder tests were used to establish the relationship between Reynolds numbers and drag coefficient. There is no doubt that the stationary tests examined drag coefficient, smoothness and the relationship to the Reynolds number. However, it did not address VIV suppression.

The Examiner then cites page 684, stating that the tests using the cylindrical elements of the claimed K/D range resulted in determining that surface roughness had an important

effect on drag and VIV response of circular cylinders. The Allen Article supports the Examiner's conclusion only as to the drag coefficient – not as to VIV:

- (a) small levels of roughness can have a tremendous effect on the drag coefficient of supercritical Reynolds number flow past stationary and vibrating cylinders; and
- (b) significant VIV response is observed at supercritical Reynolds numbers and is accompanied by substantial increases in the mean drag coefficient.

Allen Article at 684 (emphasis added).

Fig. 6 of the Allen Article makes it clear that significant VIV response means an increase in VIV displacement. It does not suggest that surface smoothness has the effect of reducing VIV in the claimed smoothness ranges. At most, the Allen Article suggests that further study is required to determine the nature of the relationships between Reynolds numbers, surface roughness, and turbulence on the VIV response and drag of the cylindrical body. There is nothing in the article to suggest or support that a body having a surface smoothness in the claimed K/D range results in a reduction of VIV. See, Allen Declaration ¶¶13 – 16. The conclusions drawn by the Examiner regarding the Allen Article are clearly not supported by the reference. Accordingly, claims 1 and 4 are patentable over the reference.

Rejection of Claims 1 – 6 Under 35 U.S.C. §103

a. Blevins '614 and the Articles

In Paragraphs 5 and 6 of the Office Action, the Examiner rejects claims 1 – 6 as being obvious over US Patent 6,206,614 to Blevins, in view of Sellens, R., Mech 441: Losses In Piping; CE/ME 101 abc handout #5, Incompressible Flow over a Circular Cylinder; or Drag of Blunt Bodies and Streamlined Bodies; or Transition Prediction in Flow over Roughness Elements or the August 20, 2001 email from Prof. Smits regarding smooth surfaces and its effects on turbulent flow. Attorney respectfully traverses the rejection.

Blevins '614 addresses VIV suppression based on relative position of two or more bluff or cylindrical bodies (col. 4, lines 13 – 45). The Examiner states that Blevins '614 is silent on construction or materials and do not teach the specific feature that the surface or surface coating is smooth within the claimed K/D range. The Examiner then takes official notice that smooth surfaces are known to create less turbulent flow than rough surfaces. The Examiner then cites the above references to reach the conclusion that it would have been obvious to one of ordinary skill in the art to include sleeves or fairings of Blevins '614 with smooth surfaces or coatings having a K/D range claimed in order to minimize drag and friction.

In taking official notice, the Examiner fails to point out how any of the articles cited suggest that a reduction in surface roughness relates to a reduction in VIV. A reduction in roughness can lead to a reduction in friction and less turbulent flow. However, as noted in Allen Declaration ¶7, VIV can occur in laminar or turbulent flow regimes. Thus, a reduction in turbulence, as a function of a reduction in surface roughness, does not directly lead a reduction in VIV. Nor does a reduction in drag directly lead to reduction in VIV. Allen Declaration ¶¶7, 15 – 17. While the CE/ME101 handout depicts a Von Karaman vortex street, it does not in any way disclose, teach or suggest that smoother surface leads to a reduction in VIV.

The suggested combination of Blevins '614 with any of the articles suggests is that if one coated the structures of Blevins '614, a decrease in friction and turbulence could result. However, there is nothing to suggest that a further reduction in VIV response would result from the ultra-smooth surface. Indeed, the mechanism for VIV suppression in Blevins '614 would still be a function of the spacing of the cylindrical bodies. There is nothing in the combination of Blevins '614 with any of the articles that suggest that an ultra-smooth coating would lead to a reduction in VIV response. At most they teach VIV suppression as a function of spacing and a reduction in turbulent flow about the columns. The addition of a smooth-surface about the structure of Blevins '614 does not in any way disclose, teach or suggest a reduction in drag and VIV response as a result of the smoothness. Accordingly, claims 1 – 6 are patentable over the cited combination of references.

b. The Allen Article

In Paragraph 7 of the Office Action, the Examiner rejects claims 2, 3, 5 and 6 as being obvious over the Allen Article. It is asserted that Allen teaches all of the elements except that the cylinders can be made ultra-smooth by the addition of a coating or sleeve. The Examiner states the is would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the Allen paper to include sleeves or fairings with smooth surfaces or smooth coatings in order to minimize drag and friction. Attorney respectfully traverses the rejection.

First, the Allen Article with its disclosed K/D ranges, as discussed above with respect to the rejection under §102, does not disclose, teach or suggest a reduction in VIV suppression as a result of the smooth surfaces. In fact, the conclusion of the Allen Article specifically teaches away, stating that "significant VIV response is observed at supercritical Reynolds numbers and is accompanied by substantial increases in the mean drag coefficient." There is nothing to suggest that the addition of coatings or sleeves to achieve an ultra-smooth surface in the range of Allen Article would lead to a reduction in drag and VIV.

Second, as noted above, a reduction in friction or drag does not in itself lead to a reduction in VIV response as required by the amended claims. Allen Declaration ¶¶7, 15 – 17. Third, the Examiner inappropriately discusses fairings with respect to amended claims. Fairings are known to reduce VIV response in the hydrodynamic field. See, e.g., US Patent 6,179,524, assigned to the assignee of the present invention. Fairings, as generally used within the hydrodynamic context, are shaped bodies used to modify the hydrodynamic profile of an underlying body. In the case of VIV suppression fairings, a general wing shape is used and operates to delay formation of the von Kármán vortex street to the edge of the fairing, where the forces induced by vortex shedding do not act directly on the underlying body. Herein, the profile of the underlying body is not generally changed.

The addition of a sleeve, as disclosed and claimed herein, does not modify the general cylindrical configuration of the underlying body as it still results in a generally cylindrical configuration. The addition of coatings or sleeves to obtain the smoothness disclosed in the Allen Article does not change the fact that the structures with the disclosed K/D ranges still underwent significant VIV. There is nothing to suggest a coating or sleeve in the disclosed K/D ranges about the cylinder would reduce VIV. Accordingly, claims 2, 3, 5 and 6 are patentable over the cited art.

c. Gregory '722 in view of the Roberson Text

In Paragraph 8 of the Office Action, the Examiner rejects claims 1 – 6 as being obvious over Gregory '722 in view of the Roberson text. The Examiner asserts that Gregory '722 teaches a cylindrical housing element for use in a marine production facility that has an exterior coating of fiberglass or plastic. The Examiner states that while “ultra-smooth” is not disclosed in Gregory '722, the present application states that an ultra-smooth surface could be provided by sleeves made of various materials provided that the materials met the required K/D ranges. The Examiner states “if plastic is ultra-smooth . . . the plastic or fiberglass cylindrical housing of Gregory must inherently have a K/D of 5.1×10^{-5} or smaller.” The Examiner goes on to argue that Roberson shows that glass or plastic pipe are considered smoother than copper or brass tubing having a k_s of 5×10^{-6} . The Examiner argues that no reference requires plastic or glass pipe to be further described in terms of manufacturing method and that one would necessarily select “standard” plastics, glass or fiberglass as used in the piping industry. The Examiner then claims that if plastic or glass are smoother than copper or brass, any common plastic or glass pipe would meet the required smoothness range. Based on this, it is asserted that it would have been obvious for one of ordinary skill in the art to have modified Gregory '722 to include industry standard materials or coatings to minimize drag and friction. Attorney respectfully traverses the rejection.

The Examiner herein engages in the application of improper hindsight in light of the present invention. Moreover, the suggested combination still does not disclose, teach or suggest a reduction in drag and VIV response. The Examiner suggests that the desirability, and thus the obviousness of the combination, would flow from the desire to reduce drag and friction. See, *In re Beattie*, 9754 F.2d 1309, 1311-12 (Fed. Cir. 1992). In doing so, however, the Examiner incorrectly assumes that a reduction in drag leads necessarily leads to a reduction in VIV response. See, Allen Declaration ¶¶7 - 10. There is nothing in either Gregory '722 or the Roberson text that suggests that a smooth surface in the claimed K/D range would result in reduced VIV response. The Examiner is merely selecting the references in light of the solution arrived at by the inventors and, in doing so, engages in improper hindsight. See, *Monarch Knitting Mach. Corp. v. Sulzer Morat GmbH*, 139 F.3d 877, 880 (Fed. Cir. 1998) ("defining the problem in terms of its solution reveals improper hindsight in the selection of the prior art relevant to obviousness").

Further, the Examiner states that "standard" materials would result in achieving the required K/D ranges. In doing so, the Examiner ignores the fact that "standard" glass and plastic surfaces vary widely with respect to K/D ranges. As pointed out in Allen Declaration ¶10, the "standard" ABS and PVC cylinders required special selection, handling and machining to achieve the required K/D range. Even then, the cylinders did not exhibit a reduction in VIV response. See, Allen Article conclusions. As noted above, the inherency argument based on the possibility that a material may have the required attributes is an improper basis for rejection. *Crown Operations*, 289 F.3d at 1377. There is nothing in the suggested combination that teaches, discloses or suggests that the reduction in drag would lead to a reduction in VIV response. At most, the combination might suggest that application of a plastic coating or sleeve could lead to a reduction in drag. As noted in the Allen Declaration ¶¶7 - 10, and as borne out by the tests in the Allen Article, Fig. 6, conclusions, a reduction in drag does not necessarily lead to a reduction in VIV, as required by the amended claims. Accordingly, claims 1 - 6 are patentable over the cited art.

d. Ortloff '487 and Brown '751

In Paragraph 9 of the Office Action, the Examiner rejects claims 1, 3, 4 and 5 as being obvious over Ortloff '487 in view of Brown '751. It is argued that Ortloff '87 discloses a fairing made of thermoplastic, various alloys or plastic reinforced by fiberglass. As the Examiner notes, Ortloff does not disclose an ultra-smooth surface but the Examiner posits that a plastic could be ultra-smooth and that the plastic of Ortloff would inherently have a K/D of 5.1×10^{-5} or smaller. The Examiner recognizes that Ortloff teaches a fairing shape and that Brown '751 teaches that bluff bodies may be circular-cylindrical in shape. It is argued that it would have

been obvious to one of ordinary skill in the art to modify Ortloff '487 to include "industry standard" smooth surfaces or coatings of a cylindrical body as disclosed in Brown '751 in order to minimize drag and friction over the surface. Attorney respectfully traverses the rejection.

The Examiner's argument is, quite frankly, illogical. The Examiner is in error to suggest that a smooth surface, in reducing drag, necessarily results in a reduction in VIV, as required by the amended claims. Allen Declaration ¶¶7 – 10. Indeed, an increase in drag can, in some instances, actually result in a reduction in VIV response. See, e.g., US Patent 6,309,141 assigned to assignee of the present invention "[p]rior efforts at suppressing VIV in spar hulls have centered on strakes and shrouds. However both of these efforts have tended to produce structures having high drag coefficients" (Col. 3, lines 18 - 21).

Ortloff '487 reduces VIV response as function of the fairing shape, which delays the separation of the vortices by reducing or breaking up the low pressure areas well past the body. (Col. 1, lines 47 – 54). As noted above, the common recitation of plastic in the present application and Ortloff '487, without more, does not support the Examiner's false analogy assertion that Ortloff '487 would inherently have a surface within the claimed K/D ratio. *Crown Operations*, 289 F.3d at 1377. Even if Ortloff '487 were to utilize ultra-smooth surfaces, the mechanism of VIV suppression is unchanged – it is the delay or breaking up of vortex separation to a point past the body. It has nothing to do with suppression of VIV around a cylindrical body solely as a function of the smoothness of the body, or a coating or a generally cylindrical sleeve about the body. The Examiner then attempts to combine this with the teachings of Brown '751, which suppresses VIV by the injection of fluid internal from the body to reduce flow separation. (Col. 3, lines 20 – 47). This again is a totally differing mechanism, requiring an active system to suppress VIV (as opposed to the passive systems of Ortloff '487 or the present invention).

It is axiomatic that to establish a case for obviousness, the burden is upon the Examiner to show some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. The motivation, suggestion or teaching may come explicitly from statements in the prior art, the knowledge of one of ordinary skill in the art, or, in some cases the nature of the problem to be solved. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988). Clearly there is nothing within Ortloff '487 (using fairings) or Brown '751 (fluid injection into the boundary layer) to suggest a combination which relies solely on the smoothness of the surface of a body to suppress VIV. Assuming, *arguendo*, that such a suggestion to combine the two references did exist, it does not follow that the combination two dissimilar mechanisms for suppressing VIV would result in yet a third dissimilar mechanism. There is no logical basis for arriving at the

Examiner's conclusion that the combination of Ortloff '487 and Brown '751 disclose, teach or suggest that an ultra-smooth cylinder surface, whether achieved as part of the cylinder, surface coating, or sleeve, by itself would have the effect of reducing drag and VIV. Accordingly, amended claims 1, 3, 4 and 6 are patentable over the cited art.

CONCLUSION

Attorney has responded to each and every ground for rejection raised by the Examiner. In light of the amended claims and the above arguments, Attorney respectfully submits that the claims are now in a state ready for allowance. The Examiner is invited to call the undersigned to address any questions or issues the Examiner might have prior to the issuance of any written action.

Respectfully submitted,

Donald W. Allen et al.

By Eugene R. Montalvo

Attorney, Eugene R. Montalvo
Registration No. 32,790

P. O. Box 2463
Houston, Texas 77252-2463
(713) 241-0296

APPENDIX A

In the Specification

Please amend the paragraph beginning at Page 8, line 7 to read as follows:

FIGS. 15-16 illustrate test results demonstrating the surprising practicality and effectiveness of ultra-smooth surfaces. These tests were conducted in a tow tank environment with the marine element towed to develop relative motion between the test subject and the water. FIG. 15 illustrates transverse root-mean-square (RMS) displacement as a function of the Reynolds number for an ultra-smooth cylinder and for relatively rough cylinders representing marine elements. FIG. 16 illustrates drag coefficient as a function of Reynolds number for the same samples. The dimensionless roughness parameter K/D for these samples were:

In the Claims

Please amend claims 2, 3, 5 and 6 to read as follows:

2. (Second Amended) [The] A method of controlling drag and vortex induced vibration about a substantially cylindrical marine element by [in accordance with Claim 1, where] providing [the] an ultra-smooth surface [comprises providing a] coating about the cylindrical element having a K/D ratio of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element including the coating.

3. (Second Amended) [The] A method of controlling drag and vortex induced vibration about a substantially cylindrical marine element by [in accordance with Claim 1 wherein] providing [the] an ultra-smooth surface [comprises providing a] substantially cylindrical sleeve about the cylindrical element having a K/D ratio of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element, including the sleeve.

5. (Second Amended) A system for controlling drag and vortex induced vibration [in accordance with Claim 4 wherein the ultra-smooth cylindrical surface is] comprised of a substantially cylindrical marine element having an ultra-smooth coating material with a K/D roughness parameter of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element including the coating.

6. (Second Amended) A system for controlling drag and vortex induced vibration [in accordance with Claim 4, wherein the ultra-smooth cylindrical surface is] comprised of a substantially cylindrical marine element having an ultra-smooth substantially cylindrical sleeve [substantially] surrounding the marine element with a K/D roughness parameter of 1.0×10^{-4} or less where:

K is an average measured surface peak to trough peak distance; and

D is an effective outside diameter of the cylindrical element including the cylindrical sleeve.



EXHIBIT A

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